National Port Strategy Assessment

National Association of Clean Air Agencies

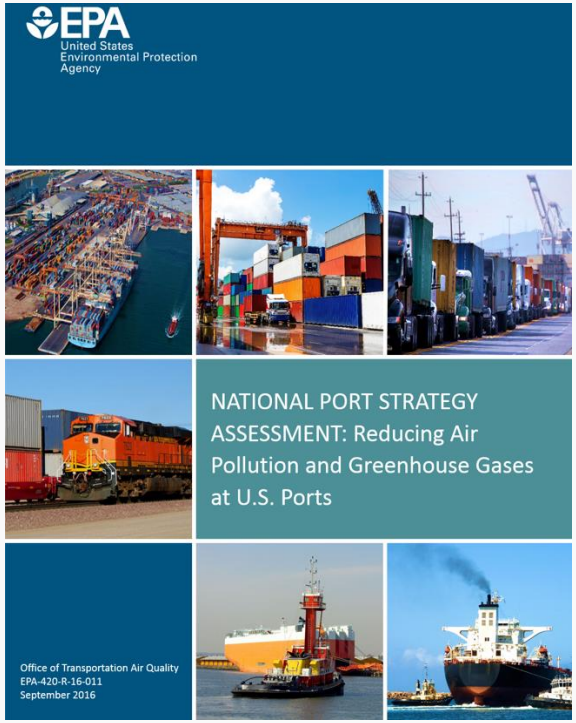
October 25, 2016





Background

- *National Port Strategy Assessment: Reducing Air Pollution and Greenhouse Gases at U.S. Ports*
- Released September 22, 2016
- Available at: https://www.epa.gov/ports-initiative/national-port-strategy-assessment
- EPA developed this assessment in consultation with the Mobile Sources Technical Review Subcommittee
- Extensive outreach underway, and webinar(s) are being planned



Purpose of Assessment

- Examine current and future emissions from a variety of diesel sources operating at ports
- Explore the potential effectiveness of a range of emission reduction strategies
- Inform EPA's Ports Initiative and voluntary port-related efforts across the country

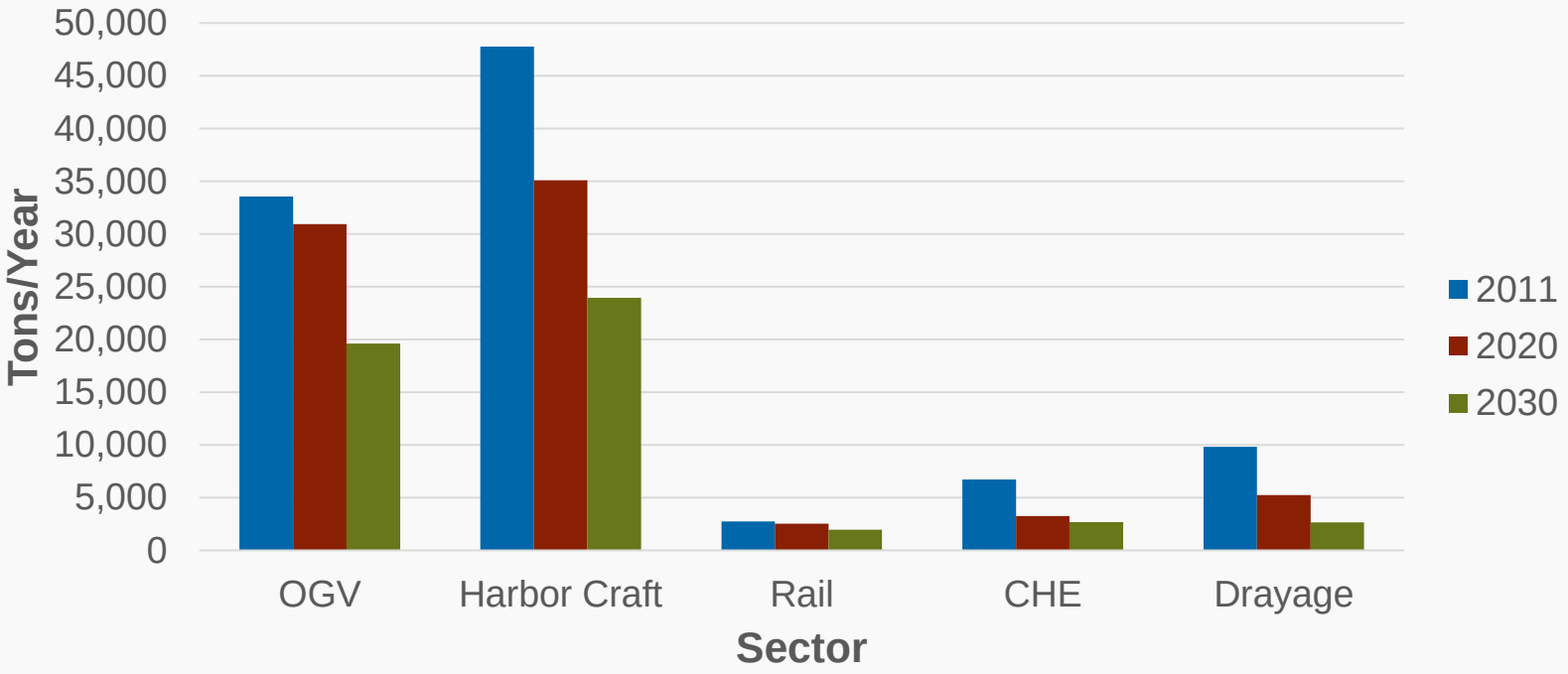
Assessment Overview

- Estimated 2011 baseline emissions
  - NOx, $PM_{2.5}$, VOC, SO_2, CO_2, BC, and air toxics (acetaldehyde, benzene, and formaldehyde)
- Estimated business-as-usual (BAU) inventories for 2020, 2030, and 2050 (CO_2 only)
- Estimated potential emission reductions for 2 scenarios:
  - Scenario A: Faster introduction of newer technologies in port vehicles and equipment beyond what would occur through normal fleet turnover
  - Scenario B: Further acceleration of clean diesel and zero emissions vehicles and equipment beyond Scenario A
- Some operational strategies were also included in both scenarios for some mobile source sectors

Understanding Current and Future Trends of Port-related Emissions –

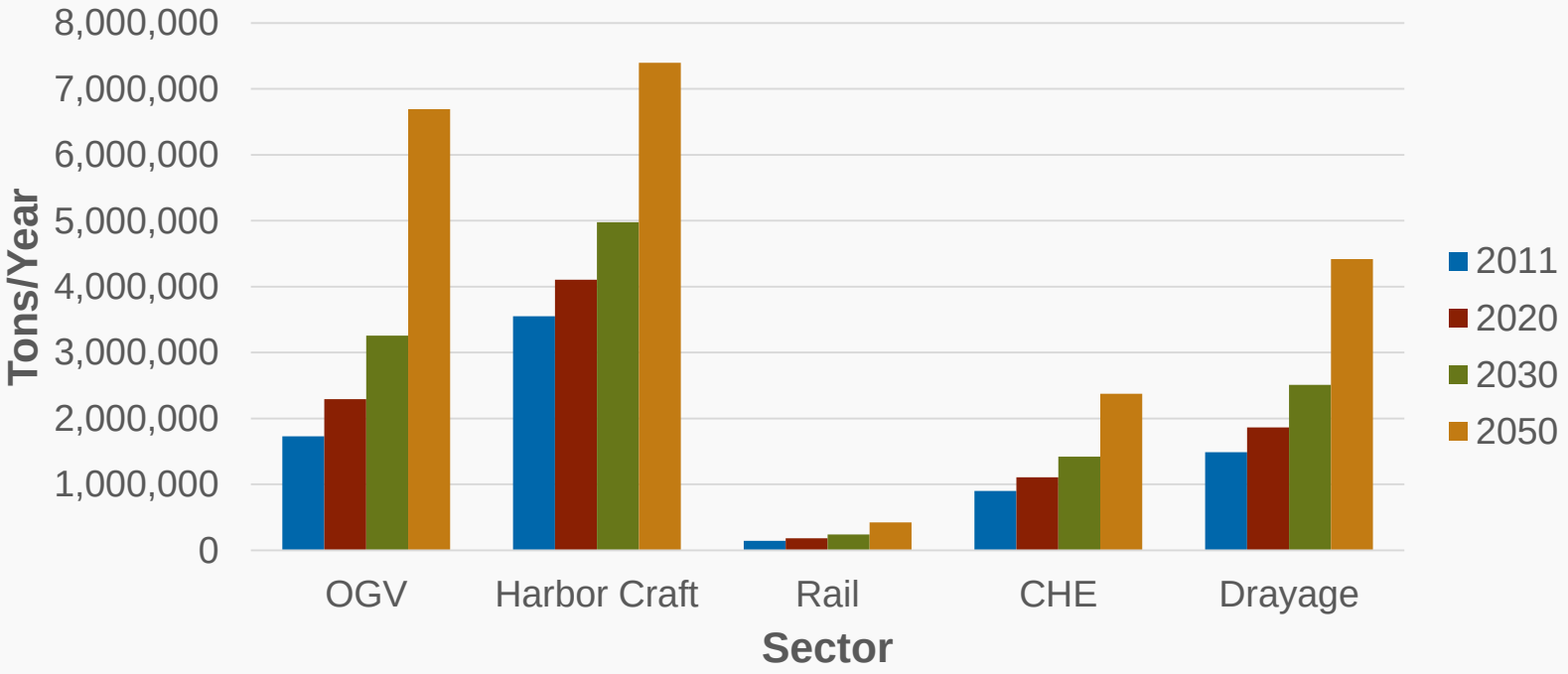
Where are we starting from?

Total NOx Emissions Aggregated by Sector, Tons/Year



Note: Modeling domain covered 5-10 km from port for ships and 0.5 km from port for rail and drayage trucks.

Total CO_2 Emissions Aggregated by Sector, Tons/Year



Note: EPA's Phase I and II HD GHG truck regulations and the IMO's energy efficiency design index (EEDI) requirements are not reflected in these results. If included, we would expect smaller increases in these sectors in 2030 and 2050.

Strategies and Scenarios to Reduce Future Emissions –

What is the potential?

Non-OGV Strategies Modeled

Mobile Source Sector	Strategy	Applied to:
Drayage Trucks	Cleaner Technology	On-road Trucks
	Operational Improvements	
Rail	Cleaner Technology	Line Haulers, Switchers
	Operational Improvements	Line Haulers
Cargo Handling Equipment	Cleaner Technology	Yard Trucks, RTG Cranes, Container Handlers
Harbor Craft	Cleaner Technology	Tugs, Ferries

Note: See Appendix for a summary of all strategy scenarios modeled.

OGV Strategies

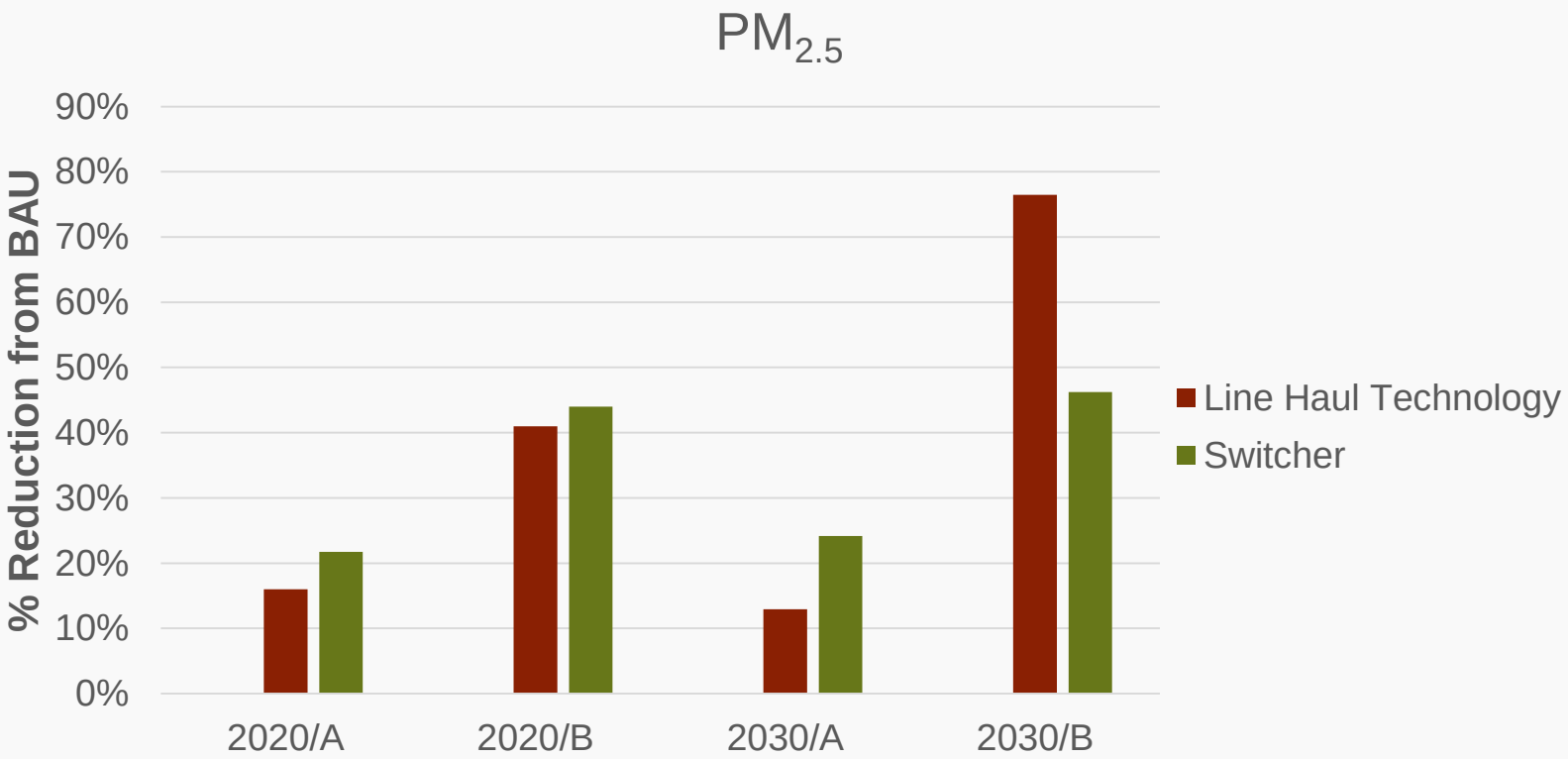
Strategy:	Applied to:
Fuel Changes (lower sulfur levels, LNG)	Propulsion & Auxiliary Engines
Shore Power	Frequent Callers Only
Advanced Marine Emissions Control Systems (AMECS)	Non-frequent Callers Only (container & tanker)
Reduced Hoteling	Container Ships Only

Note: See Appendix for a summary of all strategy scenarios modeled.

Example: Rail Strategy Scenarios

Scenario	Line-haul Technology Strategy	Switcher Technology Strategy
2020/A	Replace 50% of Tier 0+ engines with Tier 2+ engines	Replace 50% of Pre-Tier 0 engines with 95% Tier 2+ engines and 5% Tier 4 Genset
2020/B	Replace 100% of Tier 0+ engines with 50% 2+ engines and 50% Tier 4 engines	Replace all Pre-Tier 0 engines with 90% Tier 2+ and 10% Tier 4 Genset
2030/A	Replace 100% of Tier 1+ and earlier engines with 50% 2+ engines and 50% Tier 4 engines	Replace all Pre-Tier 0 engines and 20% of Tier 0+ with 90% Tier 2+ engines and 10% Tier 4 Genset
2030/B	Replace all pre-Tier 4 engines with Tier 4 engines	Replace all Pre-Tier 0 engines and 40% of Tier 0+ with 70% Tier 4 engines and 30% Tier 4 Genset

Potential Reductions: Rail Strategy

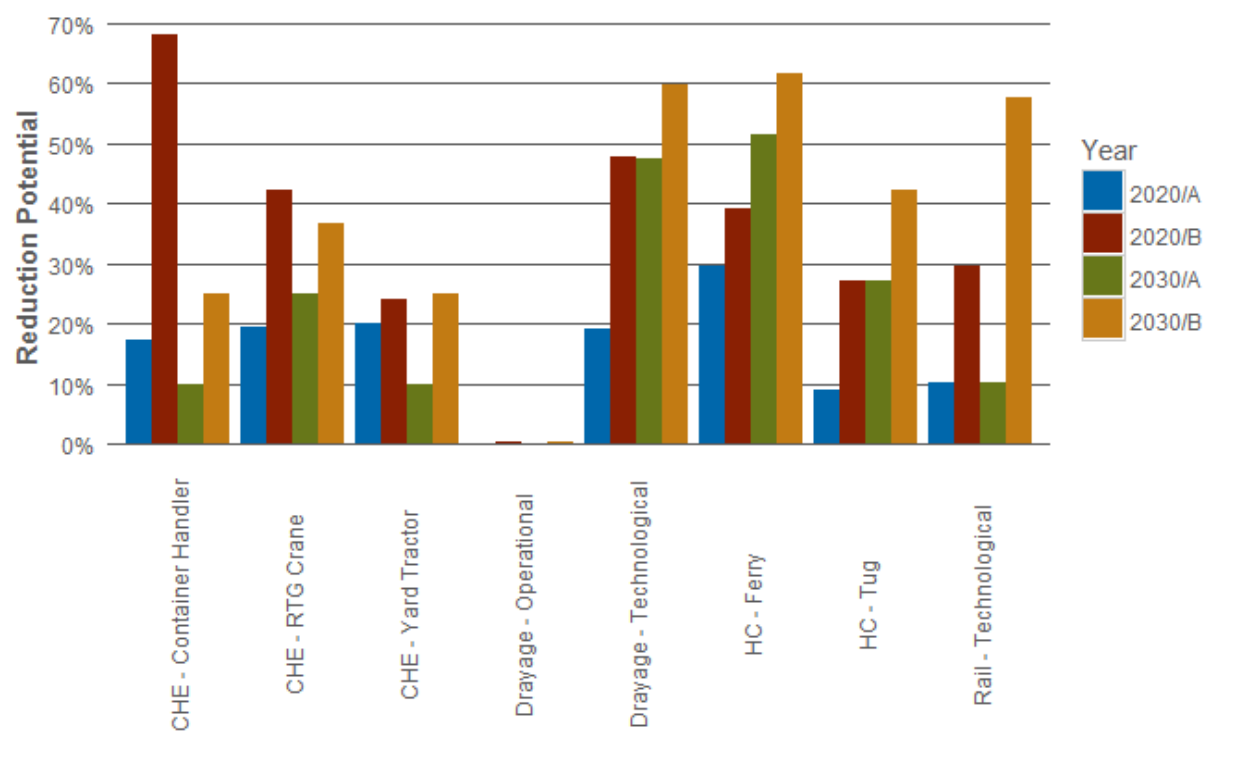


Key Findings of the National Port Strategy Assessment

What did we learn?

Progress is happening, but more emission reductions are possible

NOx Relative Reduction Potential of Non-OGV Sectors



Replace older, dirtier diesel vehicles and equipment first

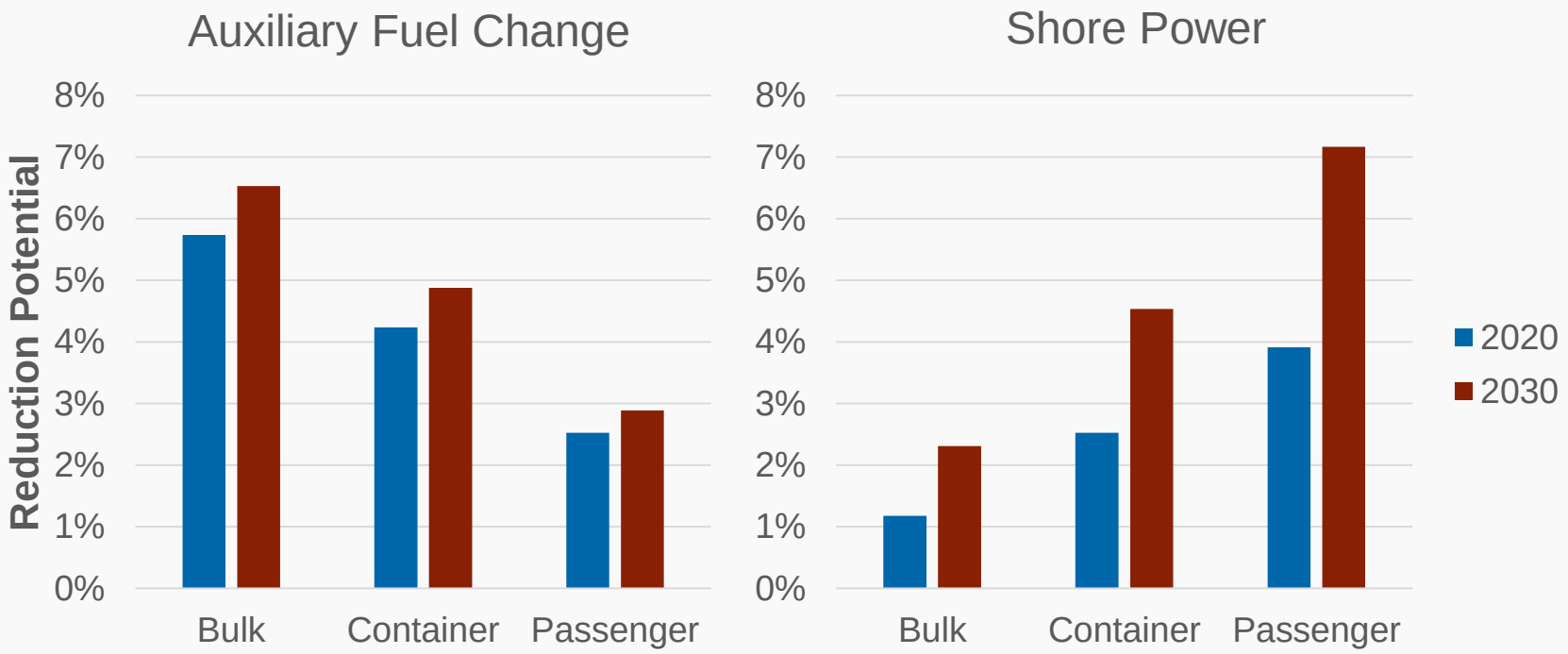
Strategy Scenario	Percent reduction from BAU			
	NOx		$PM_{2.5}$	
	2020	2030	2020	2030
Replace older drayage trucks	19–48%	48–60%	43–62%	34–52%
Replace older switcher locomotives	16–34%	17–43%	22–44%	24–47%
Replace older CHE	17–39%	13–25%	18–37%	12–25%
Replace or repower harbor craft	10–24%	25–38%	13–41%	28–37%
Reduce OGV hoteling emissions with shore power	4–9%	7–16%	3–8%	7–16%

CO_2 continues to increase, but effective strategies are available

Strategy Scenario	Percent reduction from CO_2 BAU	
	2030	2050
Replace older drayage trucks with plug-in hybrid electric trucks	0–4%	6–12%
Replace older locomotives with electric locomotives, GenSets, and fuel efficiency	3–6%	11–23%
Replace older CHE with electric technologies	7–18%	27–45%
Reduce OGV hoteling emissions with shore power	2–5%	4–10%

Effective strategies are available for every type and size of port

Example: Stratification of OGV Results for NOx (Scenario B)

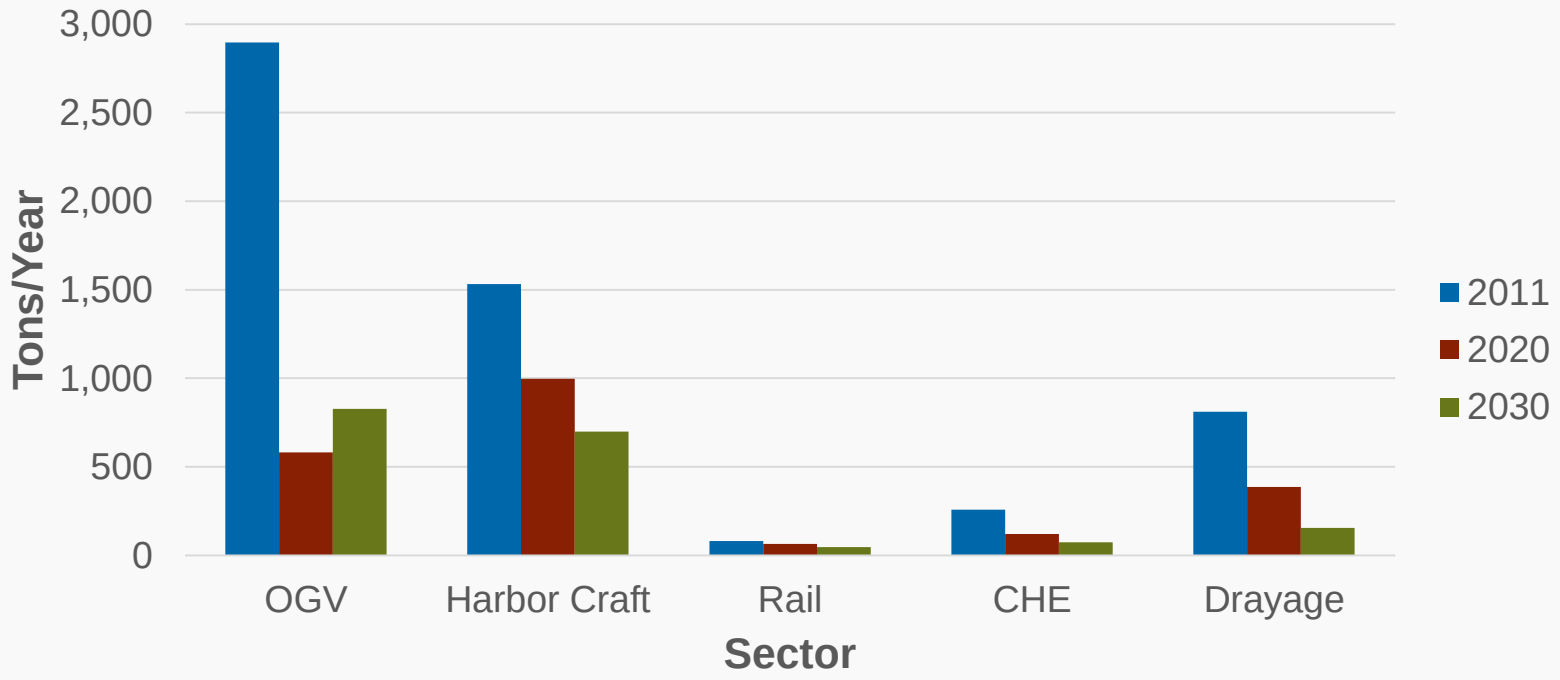


Other Key Findings

- We can reduce emissions with effective strategies that are currently available
- Reduction potential varies across mobile source sectors
- More focus is needed to reduce port-related emissions

Appendix

Total BAU $PM_{2.5}$ Emissions Aggregated by Sector



Note: Modeling domain covered 5-10 km from port for ships and 0.5 km from port for rail and drayage.

Overview of Strategy Scenarios

Sector	Strategy	Scenario Summary Description
Drayage Trucks	Technological	Truck replacement strategies to accelerate turnover to cleaner EPA standards and plug-in hybrid electric vehicles (PHEVs)
	Operational	Reduced gate queues
Rail	Line-haul Technology	Locomotive engine replacement strategies
	Line-haul Operational	Fuel economy improvements
	Switcher Technology	Switcher locomotive engine replacement strategies, including use of Gensets

Overview of Strategy Scenarios

Sector	Strategy	Scenario Summary Description
CHE	Yard Truck	Yard truck replacement strategies, including battery electric vehicles
	RTG Crane	Crane replacement strategies, including electric cranes
	Container Handler	Container handling equipment replacements, including electric equipment
Harbor Craft	Tug	Tug repower and replacement strategies, including hybrid electric vessels
	Ferry	Ferry repower and replacement strategies, including hybrid electric vessels

Overview of Strategy Scenarios

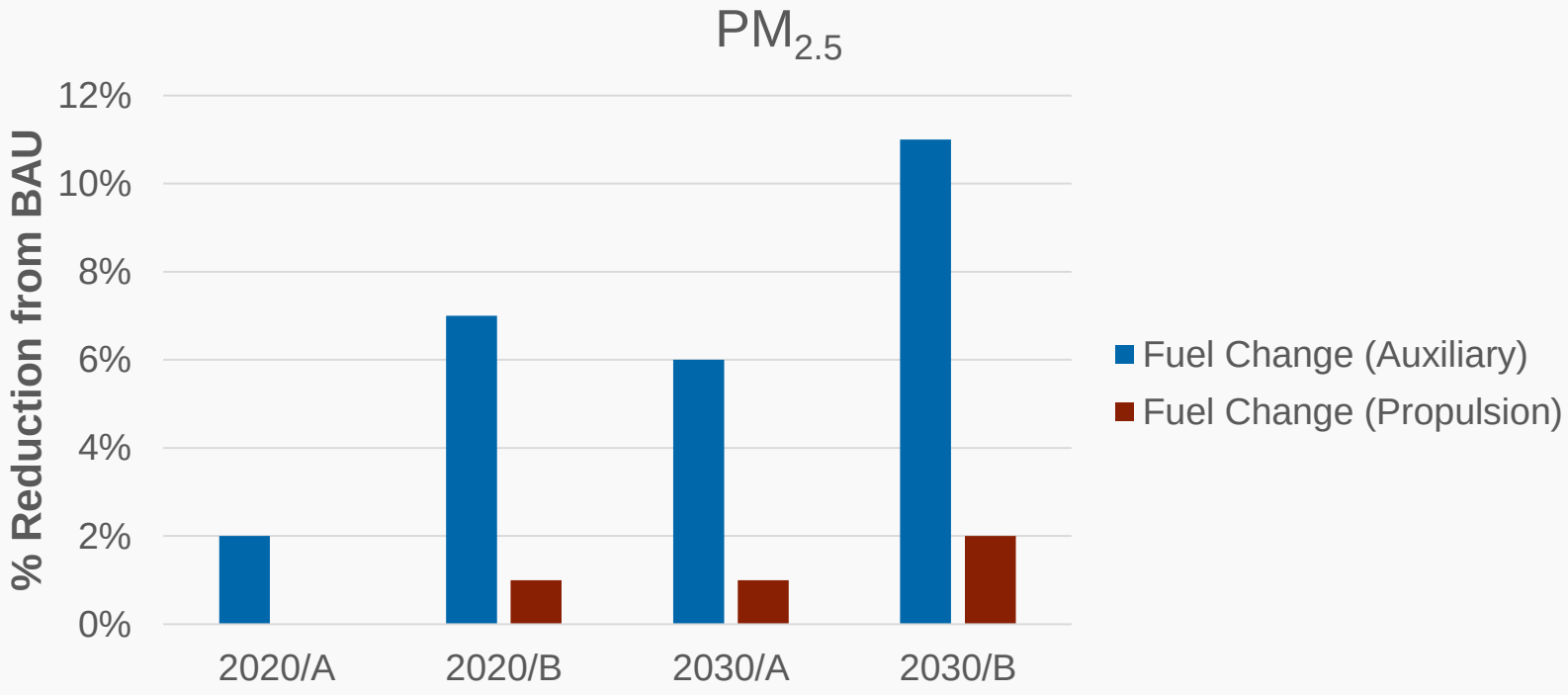
Sector	Strategy	Scenario Summary Description
OGV	Fuel Change in Propulsion Engines	Fuel use switch strategies to 500 ppm sulfur fuels, 200 ppm sulfur fuels, and liquified natural gas (LNG) for bulk, container, passenger, and tanker vessels
	Fuel Change in Auxiliary Engines	Fuel use switch strategies to ultra low sulfur diesel (ULSD) fuel and LNG for bulk, container, passenger, and tanker vessels
	Shore Power	Shore power for container, passenger, and reefer vessels
	AMECS	Advanced Marine Emission Control Systems (AMECS) for container and tanker vessels
	Reduced Hoteling	Hoteling time reduction for container vessels

OGV Example: Fuel Change Strategies

- Switch to lower sulfur diesel
  - For bulk carriers, container ships, passenger ships, and tankers
  - Use either 500 or 200 ppm S diesel fuel for propulsion
  - Use ultra-low sulfur diesel (ULSD) for auxiliary
- Switch to liquefied natural gas (LNG)
  - For bulk carriers, container ships, and tankers
  - In both propulsion and auxiliary engines
- Example:

Ship Type	2020/A	2020/B	2030/A	2030/B
Bulk	10% use 500 ppm sulfur fuel; 2% use LNG	25% use 500 ppm sulfur fuel; 10% use LNG	25% use 200 ppm sulfur fuel; 4% use LNG	50% use 200 ppm sulfur fuel; 15% use LNG

Potential Reductions: OGV Fuel Changes Strategy



Stratification Analysis

- Intended to examine impact of emission reduction strategies across different port types and sizes
- Examined OGV relative emission reductions
  - By port type: container, bulk and passenger
    - A port can be included in more than one category
  - By port size: large and small
    - Based on number of containers, mass throughput and number of passengers handled
  - Emission reductions were summed for each strategy across various groupings of the 19 ports